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A further bit of evidence as to the difference between a similarity and dissimilarity set occurs in the correlation found between a ranking for self-consistency in giving the likeness judgment and the accuracy with which hands could be paired. The ranking for consistency in giving the likeness judgment is subject to error in that six of the reagents made the two arrangements for likeness before the two for difference, while the six other reagents made the similarity arrangements second. This latter group had the practise advantage. The coefficient of correlation is probably reduced; it amounts to .515 for a first test of pairing handwritings, and .565 for a second test on pairing hands. A ranking for consistency in giving the difference judgment and accuracy in pairing of hands shows no correlation; .02 for the first test in pairing, and —.281 for the second test.

The relation of ease of judgment to material has already been mentioned. To test this specifically the shorter series of samples of writing was used. Two standards were employed, sample 15, a conventional hand, and sample 6, a highly individualized hand. With both standards the average correlation for the difference arrangements is higher than that for the likeness arrangements, but the relative increase in favor of the difference correlation is slightly higher in favor of the individualized writing. On the whole, however, the correlations are much higher for standard 15. Is this due to the choice of the standard or to the chance grouping of subjects? The group arranging the samples with reference to standard 15 had perhaps slightly the advantage with respect to subjects. Mostly, however, the situation seems to be operative in determining the results. The situation also operates, in the case of certain reagents (Ssh., Lth., Mfr.), in causing a shift in the kind of judgment showing the greater consistency. Obviously, the material utilized has so much to do with the outcome that it is desirable to evaluate it in some way.

In any case the problem of the perception of likeness and difference is so important that we should welcome any attempt such as Hollingworth's to break ground.

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REVIEWS AND ABSTRACTS OF LITERATURE

Il Metodo degli Equivalenti. AGOSTINO GEMELLI. Florence: Libreria Editrice Fiorentina. 1914. Pp. 344.

"It is a little surprising that the method of equivalents has not made more impression upon the practise and literature of experimental psychology. . . . The reason for its neglect is, in all probability, the fact that it has no direct bearing upon Weber's Law." This is Titchener's comment on the history of the method of equivalents. Besides the fact that this method does not give a measure of sensitivity, at least two more reasons may be advanced for its fate. The result of a determination by this method usually is expressed in the form of the ratio of the value of subjective equality to the objective value of the standard stimulus. The inventors of this method expected that this ratio would be fairly constant and not depend on the intensity of the standard, but this hope was not realized. To this must be added the theoretical difficulty to define the result of the method of equivalents in the terms of the method of constant stimuli. The method of constant stimuli certainly is the simplest of all psychophysical methods, and there is a general tendency among the investigators of to-day not to consider a procedure of experimentation and calculation as well understood so long as its relation to the method of constant stimuli is unexplained. This seems to be particularly hopeless in the present case, for while the method of equivalents gives the subjective equivalent, but no measure of sensitivity, the latter procedure gives a measure of sensitivity, but no value of subjective equality. Not until recent years has the problem been attacked to define the point of subjective equality in terms of the method of constant stimuli.

Gemelli undertakes an experimental investigation of the first point. Using an esthesiometer of his own invention, he determines by the procedure of minimal variations in the methods of equivalents the subjective equivalents of cutaneous distances presented on the forehead, the chest, the forearm, and the back. The standard distances varied from threshold values to 12 cm. The ratios of the subjective equivalents to the objective values of the standards set in with very high values and decrease with increasing standard. For standards of about 8 cm. this ratio is smallest, and from this point on they increase again. Some of the values found by Gemelli are almost as high as those obtained by Miss Washburn, but it seems that this agreement is closest for very large and very small standards. The value of this ratio also depends on the sensitivity of the parts of the skin to which the stimulus is applied, and it is the larger the greater the difference in sensitivity of the two points stimulated. This indicates that this ratio increases with the difficulties the subject encounters in comparing the two distances.

The next point investigated is the influence of the pressure exerted by the points of the esthesiometer, which was constructed in such a way as to control the pressure. It is found that a higher pressure increases the sensitivity, since the greater the sensitivity, the more the ratio approaches unity. The ratio of the subjective equivalents to the objective value of the standards differs less from unity, as the pressure is increased. This result is in agreement with the observations of Miss Cook and v. Frey.

One of the most interesting problems which lends itself to an investigation by the method of equivalents is the influence of optical images on our estimation of cutaneous distances. Gemelli tries to analyze this by determining the equivalents of distances given on the forehead and on the arm, and on the chest and on the arm. In one group of experiments the arm was kept stretched out along the body, while in the other group it was abducted as far as possible. The distance on the arm in the distal position is underestimated compared with the impression which is received when in its normal position. In other words, when a part of our body is removed from the median line, distances on this member are underestimated. Gemelli believes that this underestimation is due to the influence of optical images, and tries to prove this assertion by a series of similar experiments on two blind subjects who show no such underestimation. Without going into the details of this subtle argument we like to remark that it is not quite on the level of the investigations in which the subject is asked in one group of experiments to produce these images as vividly as possible, while in another group he is asked to suppress them. This is a typical case of psychological experimentation, in which systematic use is made of introspection, while Gemelli's method is not quite so decisive and rather reminds one of behaviorist investigations.

The third part of the book, in which an introspective analysis of the process of comparison of cutaneous distances is given, is of particular interest. The process by which the subject arrives at a judgment as to the relative size of the standard and comparison lengths is regarded as a thought process, and the customary methods for its analysis are applied. This is a step in the right direction, for psychophysics is just as much in need of a qualitative analysis of the process of comparison as of an exact understanding of the methods for evaluating the results obtained. Gemelli's merit on this point is undisputed, although his originality is not quite as great as he believes. Several authors before him have emphasized the necessity of an introspective analysis of the process by which we arrive at a judgment about the relation of the stimuli presented.

The experiments reported in this book were made under the direction of Külpe and Kiesow and one can easily see the influence of their ideas. The results are given in great detail and always convey the impression of careful and conscientious work. There is no doubt that the author has advanced our knowledge materially on several points, and nothing of what shall be said is intended to retract anything from this praise. The book has the appearance of a German "Habilitationsschrift," of which it shares the good and bad points. The references are very numerous—so numerous, in fact, that one sometimes gets the impression that the purpose of the quotations is not so much to impart information to the reader as to show off the erudition of the writer. It is hardly possible that Gemelli really mastered all the publications he cites, and as a matter of fact one may doubt whether anybody in his place could have done so, since the literature on the method of equivalents is not yet properly worked over. Some of the references are incorrect. I was slightly chagrined to discover that in Italy one of the publications of which I have the weakness to regard myself as the author is attributed to one of the psychophysical Browns—Warner Brown, presumably. On the other hand, a paper is credited to me of which I have a rather superficial knowledge only. Mistakes of this kind are almost unavoidable, if the references are as numerous as in Gemelli's book.

A fundamental shortcoming of the book lies in the very formulation of the problem: Gemelli does not analyze the formal character of the method. This is due to the fact that he is not acquainted with the recent investigations on the value of subjective equality and on the method of just perceptible differences. This is peculiar, since he quotes some of my papers as well as Wirth's book, in which a long chapter is devoted to the exposition of these ideas. The first important point in an analysis of this method is to lay down a definition of the subjective equivalent in terms of the probabilities of the different judgments. The next point is the analysis of what Gemelli calls the procedure of minimal variations in the method of equivalents. This does not offer any great difficulties, since the formulæ for the method of just perceptible differences could be easily adapted so as to fit this case.

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Das Wissen der Gegenwart in Mathematik und Naturwissenschaft. Wissenschaft und Hypothese, XVI. E. PICARD. Leipzig: B. G. Teubner. 1913. Pp. 292.

"Das Wissen der Gegenwart" gives a concise and valuable history of the development of mathematics and natural science in recent years, and is concerned not only with mathematics and natural science, but also with the relation between the two. Each science has its "pre-mathematical period." For example, biology has not yet reached a point where its laws may be expressed in mathematical form, while physics is farther advanced toward such a point. And yet, as Fresnel said to Laplace, "Nature does not bother herself about analytic difficulties," so it often happens that a natural law may be expressed in mathematical form only with the greatest difficulty, and, once formulated, may need to be revised and extended.

The scientist does not object to this, but rather rejoices in it, since he regards science as growing and would have no interest in it otherwise. He aims to find a "theory" which will first order and explain known phenomena, and will then prove "fruitful" in bringing about the discovery of new phenomena. If these, in their turn, require a revision of his theory, so much the better. According to Picard's view, scientists differ essentially from two other classes of men—from certain philosophers, who aim at a fixed set of laws to explain all phenomena that are to come and who are apt to be dogmatic, fitting facts to theories; and from those who have interest only in things commercial, not realizing that "the scientific dreamers who seem buried in their theories are really men of affairs." Experiment suggests theory and theory experiment, and each is dependent on the other. But the value of a theoretical investigation is not always recognized at once; for example, "the researches of Gibbs remained for fifteen years almost wholly unknown, until one day van der Waals acquainted the Dutch chemists with their importance;" and the careful study of conic sections by the Greek geometers remained "useless" for two thousand years.